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at Mt. McKinley was 15° 08′ and the correction to any one direction, as given by the adjustment, was not greater than 11″. It is seen from this that the geographic position is well determined. The nearest point from which the mountain was observed was 204 kilometers (127 miles) while the farthest point from which it was observed was 302 kilometers (188 miles).

"Having found the distance from certain stations to the mountain, its elevation was determined from vertical angles taken at Race Point and Little, two of the stations from which horizontal directions were observed. The two values of the elevation of Mt. McKinley obtained from them are 6179.7 meters and 6194.3 meters. The weighted mean of these two elevations is 6187.5 meters or 20,300 feet. This value is identical with the mean value previously adopted by the U. S. Geological Survey which has superseded the value 20,464 feet given in the Dictionary of Altitudes, published by that Bureau in 1906.

"The coefficient of refraction which was deduced from the observations made in 1894 to determine the elevation of Mt. St. Elias was used in determining the elevation of Mt. McKinley. Its value is 0.083. It was believed to be nearer the truth than the coefficient which was determined from the reciprocal observation made in Cook Inlet in 1909, because those observations were made almost entirely over water, while the lines of the two mountains (Mt. St. Elias and Mt. McKinley) were, for the most part, over land and ice.

"It is believed that the value, 20,300 feet, for the elevation of Mt. McKinley is correct within 150 feet."

THE RETURN OF HALLEY'S COMET

The Weather Bureau of the Manila Observatory has printed a paper* on the return of Halley's comet and the alarm manifested in some quarters over the information that, on May 18-19 the earth will pass through the tail of the visitor. The paper is very instructive and also a plain exposition of the groundlessness of fear with regard to comets in general and particularly as concerns the present return of Halley's comet. The more important information it contains is presented here.

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*The Return of Halley's Comet and Popular Apprehensions. By Rev. George M. Zwack, S. J., Secretary of the Weather Bureau. 22 pp. Manila Bureau of Printing, Manila, 1910.

Comets do not differ essentially from the sun and the planets. They are composed of matter such as we are accustomed to and are subject to gravitation and other physical laws. Halley's comet, in particular, is an old acquaintance for it revolves around the sun like the earth and is therefore visible at intervals. Its path is very eccentric and of vastly greater length than that of our earth, so that it needs over 76 years to complete one revolution; but this does not alter the truth that it belongs to the group of cosmical bodies that revolve around our sun. About 75 comets are known to move in elliptical orbits around the sun, some 15 of which have periods of revolution exceeding 100 years, though many others have much shorter periods.

There is also a vast number of comets that are seen only once because their orbits are parabolic or hyperbolic-curves whose branches separate farther and farther. They whisk around our sun at tremendous speed that carries them beyond its controlling force; and passing out into boundless space again they doubtless fall at last under the dominating influence of some sun and become members of its solar system.

From the earliest times to the present, about 700 comets have been recorded of which only about one-fifth were visible to the naked eye. As many as eight have been found in a single year—five in 1909. Such remarkable specimens as the great comets of 1858 and 1882 are rare, nor are they those, as a rule, that approach nearest the earth.

These comets have had their periods of revolution changed, by the attraction of the earth, by amounts measured by weeks, but the earth's even course through the heavens has not been at all affected by the comets. Lexell's comet in 1770 came within 1,520,000 miles of the earth, which was probably the nearest approach; but no effect whatever upon the earth could be detected.

Comets are exceedingly large, but they are also exceedingly flimsy. The head of Enke's comet (which is not a large one) has a diameter of 300,000 miles when it first becomes visible. This diameter diminishes as the comet approaches the sun. The tails of comets are rarely less than 10,000,000 miles long. If these immense bodies had the density of our earth, the effect of their attraction upon the motion of the earth would be very appreciable; but not the slightest effect can be observed. Not one of these comets can have weighed even one two-hundred-fifty-thousandth part of the earth. A comet 40,000 miles in diameter would probably have a mean density of a little less than one nine-thousandth of that of the air at the earth's surface, or much less than has the residual air in a vacuum tube exhausted by the best air pump. There is no danger that the earth will ever be thrown into new and disastrous paths by the attractive force of a comet.

But is there not danger that some harmful matter may stream into our atmosphere, suffocating every living creature or setting the earth on fire? It has been figured out that, on May 18-19, this year, our earth will probably come within the tail of Halley's comet. The head of the comet will, on that day, be at its closest approach to the earth, over 13,000,000 miles away. But the earth will be mixed up with the tail and what will be the result?

One thing is certain and that is that comets, as a whole, are not luminous by incandescence. The spectroscope tells us that their light is, in part, reflected sunlight, but there is also an emission spectrum which reveals the presence of some gaseous carbon compound that may be cyanogen or some hydrocarbon, if not both. The facts collected have made it perfectly evident that there can be no danger that the comet's tail can set fire to the earth or to its atmosphere.

But what about the gases constituting the tail and their effect upon life? Cyanogen is mentioned as probably a constituent part of comets and it is a poisonous gas. Assuming that the tail is formed of gas or other ponderable matter, some cyanogen, if it is present, would, no doubt be picked up by the earth and remain in the atmosphere. Now as the whole comet is, in mass, perhaps equal to our atmosphere and as the earth would come into contact with only a very small part of it, the head of the comet being 13,000,000 miles away, the quantity entering our atmosphere would be far less than 0.00000001 of 1 per cent. One hundred thousand times this amount would be absolutely harmless, no matter what the gas might be.

However, the argument best calculated to dispel all apprehensions regarding the passage through a comet's tail consists in the fact that the thing actually happened less than a half century ago. According to several astronomers of repute, the earth traversed the tail of the great comet of 1861 at 6 o'clock and 12 minutes a. m. on June 30, 1861, some 300,000 miles within it, and approximately two-thirds of its entire length from the head. Nothing was noticed except a faint luminosity, resembling the zodiacal light, which was seen in the evening of that day. "It is perfectly clear, from all the data known, that Halley's comet, at least at its present return, cannot possibly do any mischief by either tumbling into the sun or colliding with the earth. Its least distance from the former will exceed 54,000,000 miles; from the latter it will be 13,000,000 miles. As comets have passed unscathed as close as 750,000 miles from the sun, there can be no danger of the present comet falling into it."

The writer then discusses the question of the possibility of the collision of a comet with the sun or our earth. None of the periodic comets is likely ever to fall into the sun unless it be Enke's comet. The period of this small comet (nearly 3⅓ years) is continually shortening, first by 2.5 hours a revolution, but since 1868 by only half that amount. If this state of affairs continues indefinitely, the comet will finally fall into the sun. But there is no prospect of this for many thousands of years. Even if the acceleration of its degree of speed should continue at the present rate, the comet's nearest distance from the sun (perihelion distance), 4,500 years from now, would still be ten times as great as that of the comet of 1882 which passed the sun in safety.

It is different with the non-periodic comets. It is very improbable but still possible that, sometime, one of these wanderers will collide with the sun. The late Prof. Charles A. Young expressed the view that if a comet should actually strike the sun, no harm would be done. Of course, an enormous amount of heat would be generated but, in the opinion of this astronomer, the cometary particles would pierce the photosphere and liberate their heat mostly below the solar surface simply expanding the sun's diameter slightly, and so adding to its store of potential energy about as much as it ordinarily expends in a few hours.

The chances of a collision between a comet and the earth are less than of a comet falling into the sun, so far as relates to comets with non-elliptical orbits, since the diameter of the earth is less than 0.01 that of the sun. It is vastly different, however, with the periodic comets. "The orbits of several of them pass closer to the earth's path than the semi-diameter of their heads. Therefore, provided both the earth and the comet last long enough, the two bodies are bound to come together. But such encounters are extremely rare. Babinet estimates that their likelihood is about one in 15,000,000 years."

The author speaks of the possibility of a collision of the earth with a periodic comet but adds the qualification, "provided both the earth and the comet last long enough." This reservation was suggested by the history of the small comet discovered in 1826 by Biela.

It was a small comet with a period of 6.6 years and its orbit came within a few thousand miles of that of the earth. If they had ever arrived simultaneously at the point of least distance, the earth would have passed through the outer portion of the comet's head. But the comet failed to last long enough. On its third return in 1846, the comet divided into two parts while in full view. When the parts were seen again in 1852 they were about 1,500,000 miles from each other. Since then they have not been seen though they should have reappeared no less than eight times. On the night of Nov. 27, 1872, while the earth was passing the path of the old comet, she encountered a magnificent display of meteors. Similar displays were seen at the usual period of the passage of the comet, in 1885 and 1892.

Of course the nuclei of a comet cannot be solid, for they expand and contract by many thousands of miles. But if the earth were bombarded by the combined energy of the meteors forming the head no living being could survive the ensuing rise in temperature. The ruin would be far greater if there were a head on collision. This would simply mean the end of the world as far as the human race is concerned.

This is bound to happen, sometime, if the earth lasts long enough and comets do not become extinct. But what are the chances? Arago figured out that the chance of any individual comet striking the earth is as 1 to 281,000,000. But all this is nothing to worry about. It takes infinitely less to snuff out the candle of our life than a collision between the earth and a comet. Science tells us that the end of the world as the abode of life is surely coming—and this is infinitely more certain than that the earth will ever be in collision with a comet.

OUTBURST OF THE PEAK OF TENERIFFE

A volcanic eruption of the Peak of Teneriffe began on Nov. 18 last and continued for several days. The world had almost forgotten that this lofty mountain in the Canary Islands, whose summit is often covered with snow, is an active volcano. Many had believed that its fire were almost extinct. Some evidence of life remained, however, for its crater has often given feeble testimony to this fact. But the history of the Peak shows, just as the records of Vesuvius and Cameroon Mountain have shown, that the complete